JANUARY 1950

THE MGA BULLETIN

No. 18

ORGAN OF THE MUSHROOM GROWERS' ASSOCIATION

CONTENTS

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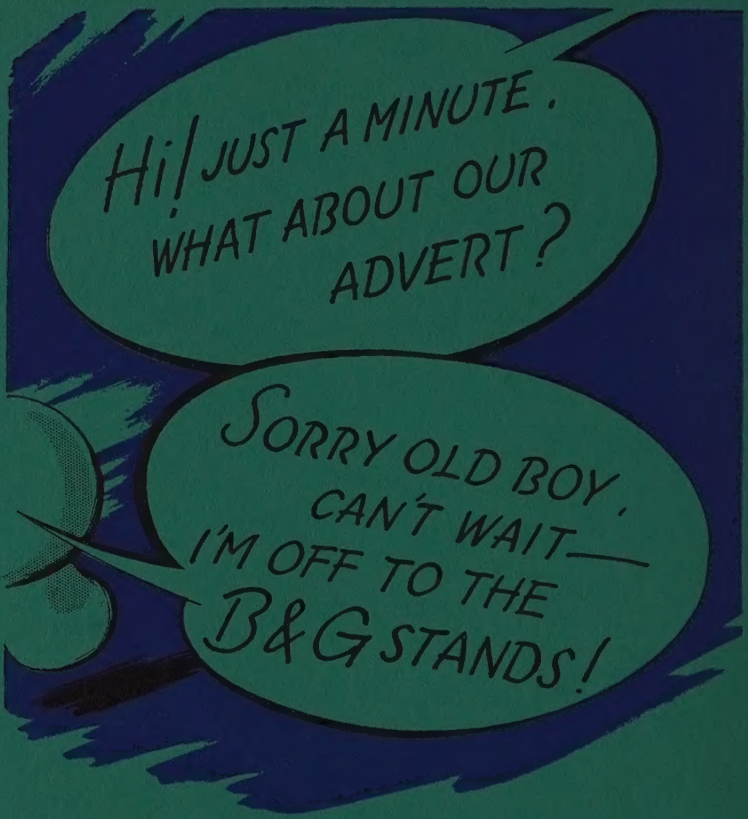

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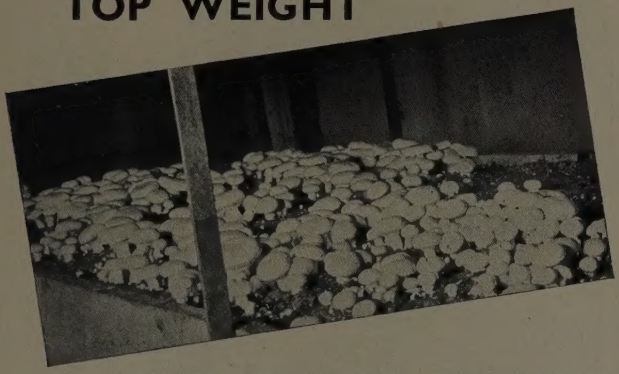

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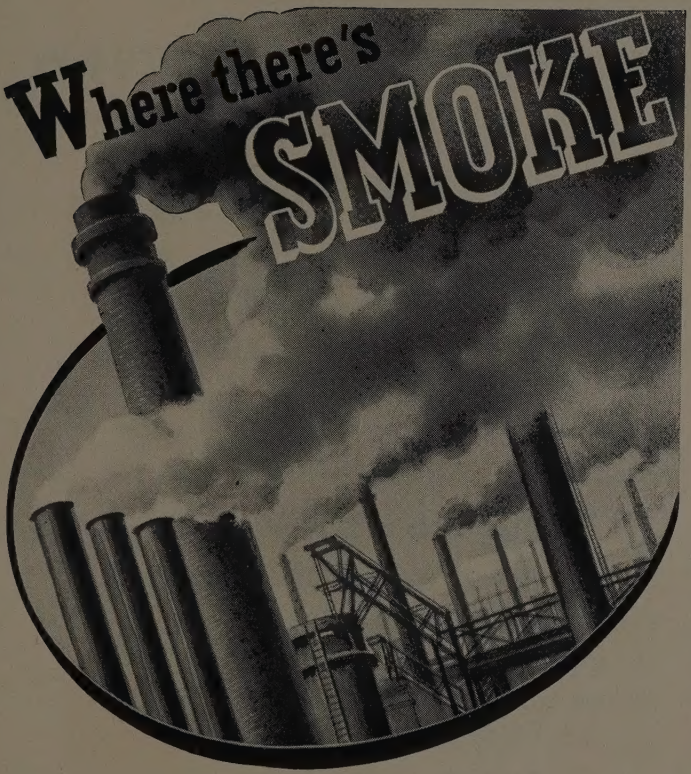

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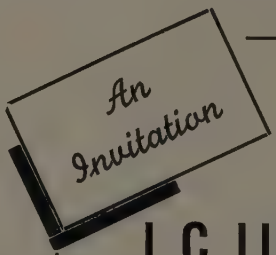

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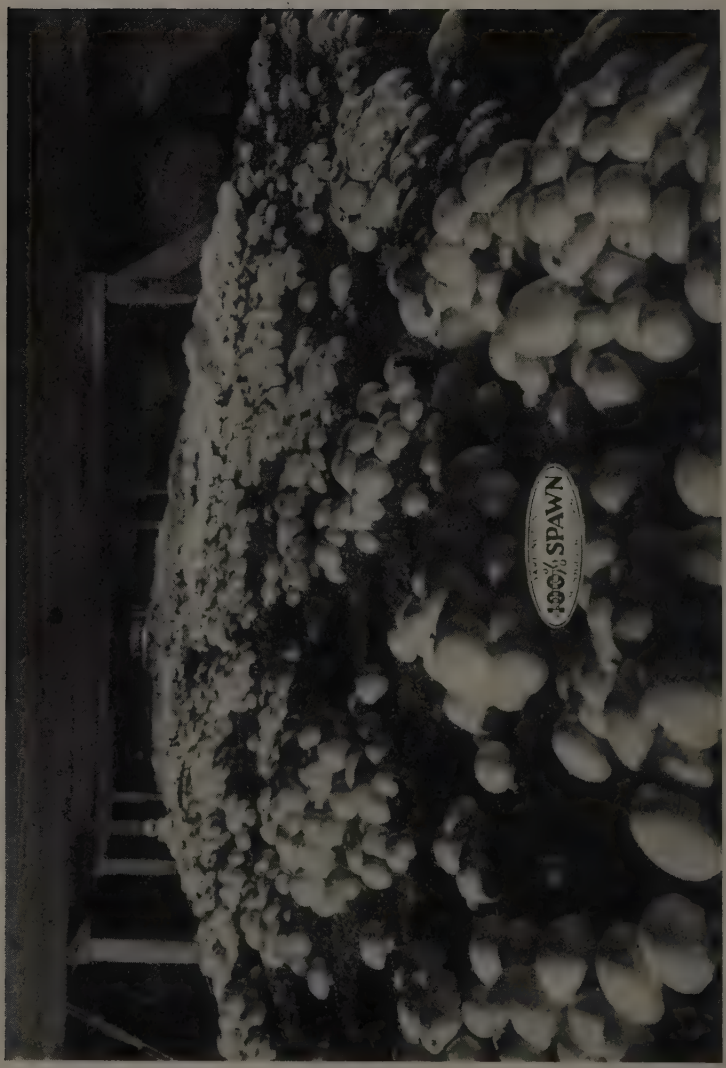
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THE

JANUARY 1950

BULLETIN No. 18

No responsibility can be accepted by the Editor, the Editorial Board, or the Mushroom Growers' Association, for statements made or views expressed in this Bulletin, or for any advertisements included in this publication.

A NEW YEAR WISH —AND A RESOLUTION

Our new Chairman writes :

The Old Wish is the Best Wish—A Happy and Prosperous New Year to all Members of the M.G.A.

But do not let us leave it at that—just a " wish." We want our Industry to prosper, and this can only be by our individual and united efforts.

We are threatened by imports from other countries, whose workers have a lower standard of living than ours. We must boldly face these imports. We are a Specialist Branch of the N.F.U., and all the resources of this great Union are with us in the battle against foreign competition.

For our own part we must make use of all the improvements which Science and Research can place at our disposal.

We have an excellent Research Station, well-equipped and staffed with experts trained to deal with our problems. This M.R.A. Research Station can and will help us. The Directors on the Board see the resources of the Station are turned to those problems which will lead to improved methods of growing and increased production. Already many mushroom growers are freely admitting that their yields and the quality of their produce have greatly improved by the use of activators and the technique of " peak heating."

Let us go forward into the New Year with confidence in our Industry, determined to keep the standard of our produce above that which can come from abroad, energetically prepare to supply the home market with all the mushrooms required, and make our resolution— FULL PRODUCTION, BETTER QUALITY, GOOD MARKETING.

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NEWS FROM M.G.A. HEADQUARTERS

Now that we have started the regular issue of **News Sheets,** it has been decided to confine these quarterly Notes from the Secretary to the News Sheet—unless they are of permanent interest.

THE EDITORIAL BOARD

RESEARCH APPEAL, 1949

The Mushroom Industry—growers large and small, market salesmen, sundriesmen and others with its interests at heart—is to be congratulated on the truly splendid response made to the Appeal for contributions to enable the work at the Yaxley Research Station to continue in 1949.

A total of £2,368 18s. 8d. was received from 248 subscribers. The following cheques received since Bulletin 17 went to press are gratefully acknowledged :—

	£	s.	d.		£	s.	d.
S. J. Pointing	10	10	0	S. Holgate	5	0	0
D. B. Gill	5	5	0	Mrs. Godfroy Harris			
G. C. Smith	5	5	0	(Natal, S.A.)	2	2	0
Lt.-Col. H. G. Bell	5	0	0	M. S. Clarke	1	0	0

M.R.A. RESEARCH DIRECTORS : The Ministry of Agriculture has appointed its two representatives on the Board of Directors of the Yaxley Research Station. They are Dr. W. F. Bewley, C.B.E., D.Sc., V.M.H., Director of Research, Cheshunt, and Mr. H. H. Glassock, Advisory Plant Pathologist, N.A.A.S., South-Eastern Province (Wye). Dr. Bewley and the late Mr. H. J. Harnett wrote " The Cultivation of Mushrooms," and Mr. Glasscock recently completed the revision of the Ministry's Bulletin 34 : " Mushroom Growing," and was responsible for the new film-strip on Mushroom Growing.

FOURTH ANNUAL MEETING

The Fourth Annual Meeting of the Mushroom Growers' Association was held at the Restaurant Frascati, London, on Wednesday, 30th November.

At the outset Lt. General Sir Oliver Leese (Shropshire), Chairman, presided. He was later succeeded in office by **Mr. A. DeB. Hovell** (West Sussex), Chairman for 1950. **Mr. Fred. C. Atkins** (Northants.) was elected Vice-Chairman. **Mr. Angus Watson** was re-elected Secretary. Mr. C. P. Chamberlain (Wilts.) and Mr. R. Patterson (Northern Ireland) were re-elected to the Executive Committee, and **Mr. W. A. B. Harding** (Kent), a former member, returned to take the place of Sir Oliver Leese, who was "making way for younger blood." Messrs. F. C. Atkins, A. DeB. Hovell, **Stanley Middlebrook** (Yorkshire), J. Stewart-Wood (Bucks.) and H. S. Allsop (Scotland) were appointed M.G.A. representatives on the Mushroom Research Association's Board of Directors. (Mr. Allsop tied with Mr. C. P. Chamberlain, who gallantly withdrew his nomination to resolve the difficulty.)

At the Luncheon preceding the meeting the Guest of Honour was Dr. W. K. Slater, Secretary of the Agricultural Research Council.

A full, illustrated report will appear in the next issue of the Bulletin.

SPORENDONEMA (GEOTRICHUM) CONTROL

Dr. James Sinden writes from Pennsylvania: "I am surprised that *Sporendonema* is becoming serious. We have some over here. I observed it in one house this week where it was developing over the surface of the soil in patches about two feet in diameter. The grower mistook it for Truffle. **He could easily have controlled it by shaking over it a little 15% sodium hypochlorite dust.** This kills such infestations without allowing the spores to be disseminated, as happens when a spray is used."

"MAJOR DISEASES & COMPETITORS"

Members recently received a copy of Fred. C. Atkins's "Major Diseases and Competitors of the Cultivated White Mushroom." Dr. C. J. La Touche at once pointed out to the author several errors, and he hastens to pass them on :—

Page 7 : The camera lucida drawings of fertile branches of two specimens of *Dactylium dendroides* were obtained from different sources. That on the left represents a relatively young stage in conidium production, that on the right a late stage.

Page 17 : The single bulbil is magnified 1,000 times.

Page 22 : Conidia of *Verticillium psalliotae* are developed successively as in *V. malthousei* and also collect in drops of fluid at the tip of the phialides (La Touche).

MUTUAL AID

QUESTIONS ASKED AND ANSWERS GIVEN

EDITOR'S NOTE : No one knows all the answers. The Advice Panel does its best. The answers given below were supplied by one or other of the members of this Panel and ought not to be taken to represent the views of them all. What do you think of the answers ? Are they right—or wrong ? It would be very helpful to have your opinion.

Q. 142. *A grower, especially one working to a regular programme, will find at times that he is behindhand. He has therefore to decide to which operation he should give precedence and which can be delayed. For example, he may have beds ready for spawning and another ready for casing ; should the casing or the spawning be done first ?*

Ideally, each operation should be done at the proper time, but opinions differ so widely as to when that is that no answer can be very helpful. Peak heating should follow **immediately** on filling. Casing **can** be done at any time up to three or even four weeks after spawning, but spawning **ought** to be done as soon as the temperature of the bed falls to permissible limits. A day or two's delay should not be serious ; good planning should obviate longer postponement.

Q. 143. *I am about to fit the usual flat asbestos lining to a Handcraft Hut for use as a mushroom house. Is the air space sufficient as insulation, or will it be necessary to fill it with some insulating medium ?*

An air space is not sufficient, and of the insulating materials glass wool is one of the best. An alternative is tinfoil, but it is a little tricky to fix. Do not use sawdust, which settles in time and results in uneven insulation.

Q. 144. *We shall be glad if you can suggest a substitute for sulphur fumigation when the houses are empty. Sulphur is doing considerable damage to the metal work ?*

Sterizal or Emulsified Cresylic Acid are nowadays preferred to sulphur for washing down, with Formaldehyde as the fumigant.

Q. 145. *I have been advised to have four ventilators in my 18 ft. × 36 ft. Handcraft house. Is this sufficient ?*

It is better to have too many ventilators than too few—and four small roof vents seem inadequate. Two vents at ground level at each end of the house (which can be opened or shut at will) would be a big improvement.

Q. 146. *I have no specific disease on my farm, but crops are steadily falling. Why is this ?*

In the absence of a definite disease or pest it is difficult to advise you. Hot weather has caused much trouble recently, particularly where insulation and ventilation were poor, but your difficulties suggest what is popularly described as " site contamination," in which a general build-up of ill-health reduces crops without any specific disease appearing severely enough to explain the failure. This may be due to lack of hygiene outside the houses as well as inside, and it is important to clean paths, door handles, tools and so on, periodically.

Q. 147. *Can manure to be used for mushroom growing be stored safely from March until August ?*

Storing manure is not to be advised if it can possibly be avoided. Where it is unavoidable, the usual method is as follows :—Try to obtain the manure as dry as possible, and when stacked keep it dry by covering with several inches of soil. If the stack is in an exposed position, protect it from the weather as much as possible.

Q. 148. *What is the accepted weight and price of a cubic yard of manure ?*

This is best answered in another form. The weight of manures varies immensely, depending upon whether it is light, heavy or medium. The price is about £4 a ton for heavy and £3 a ton for light, delivered. There is a serious shortage of heavy manure. Light manure is good providing it is " pepped up " with Adco " M," or poultry manure, or better still the new M.R.A. formula (Activator A, obtainable ready mixed from Thomas Elliott Ltd.).

Q. 149. *In " Mushroom Composting Processes " I see that biotin and aneurin added to new beds two days before spawning will considerably increase crops. Where are they obtainable ?*

Our advice is not to experiment with them at this stage. Treschow did indeed find that impure extracts of these substances increased yields, but they were impure and it is by no means certain what caused the increase. The pure substances were tried once at Yaxley, with no noticeable result. And they are very expensive. We suggest you wait a little ; the M.R.A. is going to tackle this exciting field in the very near future.

Q. 150. *Am I liable for Development Charges if I put up more mushroom houses on my land ?*

According to the N.F.U. which took this matter up very strongly at the time, the regulations have now been amended so as to give exemption to any development "requisite for the farming of the land" (other than the building of dwelling-houses). We have an assurance that the word " farming " will be interpreted broadly so as to include market gardens and nursery grounds and that grading and packing sheds will also be exempt from development charges. Mushroom production is regarded as a section of Market Gardening and can be classed as " farming " in the broad sense of the word.

Concerning Question 134 in Bulletin 17 : " *We are getting masses of pinheads but few mushrooms . . . . . .* " Dr. R. L. Edwards writes : I think this might also be caused by shortage of water in the soil, possibly after it had been wet enough to start the pinheads.

Useful Year Book for all Growers

Reviewed by Fred. C. Atkins

I have long toyed with the idea of writing an Encyclopædia for Mushroom Growers, so that if any query crops up the grower can resort to one volume in which all the answers appear in alphabetical order. Trouble is, there are one or two questions I can't answer myself !

Something very close to what I have in mind has been done for the horticultural grower, however (with the accent on fruit). A handsomely-bound volume—*The Fruit Grower Year Book*, 1950 (Benn Brothers Ltd.) 8/6—carries a mass of helpful information admirably sectioned and collated. Certainly no fruit grower should be without a copy, and there is more than 8/6 worth of interest for the mushroom grower also. The sections on Growers' Co-operatives, Growers' and Allied Associations, Official Horticultural Bodies, the N.A.A.S. and County Committees and Market Salesmen are most rewarding.

Particularly helpful is the chapter " Who Makes It," giving a list of suppliers of many sundries—though why only Darlington is mentioned as supplying spawn I can't guess ; why not Monro, and Pinkerton ?

Under Growers' Associations appears the Mushroom **Research** Association but not the M.G.A. ; journalists used to be more careful about these little matters. Also for their guidance, the M.G.A. telephone number is Yaxley 391 and the M.R.A. number Yaxley 353. They give mine instead, for which I am not filled with gratitude.

There is an excellent Horticultural Bibliography, which reveals that Bewley and Harnett's little book on *The Cultivation of Mushrooms* is " reprinting." Good ; we've been without for too long.

One or two questions. Would you say the quarter-bushell returnable box (13″ × 9¼″ × 6″ or 6½″) is " an approved standard container " for mushrooms ? Nor would I. Nor do I think the No. 12 taper chip-basket likely to be popular. Has *The Fruit Grower* never heard of Gammexane against mushroom pests ? And why, oh why, in its list of Horticultural Imports is there no reference to mushrooms ? We know they are coming in this year in hundreds of tons ; why ignore the fact ?

Intensive Growing in Danger

Customs Union May Revolutionise our Horticulture

A Special Correspondent to the Fruit Trades Journal (12*th March*, 1949) *sounds a warning to growers throughout Britain that their livelihood is seriously menaced by contemporary European trade movements. This important article is reproduced by permission of the Editor of the Journal.*

Remote indeed seems the single acre Lancashire glasshouse or the Sussex small-holding from ponderous motions tabled in Parliament and the high-powered deliberations of statesmen about means of bringing about closer and more genuine European unity. Yet there is no branch of Britain's great horticultural industry which is not vitally affected by the outcome of these present negotiations.

Reflect on the strikingly rapid speed with which the movement for a United Europe has gathered strength. Under the impetus of Mr. Marshall's E.R.P. and the Churchill-Bevin movement for a United Europe ; with the formation and progressive working of half a dozen important European economic bodies, and with the terrifying stimulus negatively administered by the fear of Russian power in the East, the road towards economic unity is half traversed already.

Britain has reached the stage, at least in principle, where she is willing to adapt her economy to conform, but not conflict, with those of other Western European countries—France, the Low Countries, Italy and Scandinavia foremost among them. The Geneva trade agreement marked the first step towards putting into operation the theories of international co-operation. The movement towards freer trade had started. The Havana conference a few months later encouraged all participating countries to speed their efforts towards breaking down trade barriers.

To-day two Socialist motions are on the Order Paper dealing with European Unity ; there has just been a conference of the International Federation of Agricultural Producers ; this spring European horticultural producers are meeting to discuss common problems.

What does all this add up to? Here are some of the facts : European unity, politically, may be a long time in maturing. It may never materialise. But a pre-requisite is closer economic co-operation, for which there are two stages : (1) Re-adjustment of national economies ; (2) A European Customs Union.

A Customs Union is coming sooner or later. There is no use evading this fact. Everything points towards it. There is not merely talk, but action—at the moment slight, but significant.

On the face of it a Customs Union would involve the complete abandonment of tariff protection against goods passing between the co-operating countries. And no branch of our economy would be more directly or seriously affected by such a disappearance of Customs duties than horticulture.

For while the world and Europe are talking about and moving rapidly towards freer trade, horticulture is digging in its heels and obstinately demanding more, not less, protection against foreign

competition. Only the strength of N.F.U. pleas and the importance accorded to the agricultural representations made there saved horticulture from a severe anti-Protectionist blow at Geneva, whose tariff agreement came into partial operation a year ago.

Since then the voice of horticulture has become weaker, not because its case for protection is less impressive, but because Governments, and especially the British Government, are tending increasingly to treat the trade in fruit and vegetables as a mere bargaining counter to effect " bi-lateral pacts " or barter agreements between two nations.

Who can fondly imagine that in the next few years the need to protect our home horticultural interests will be deemed more important than the need to weld together Europe's basic industries for military and/or economic-political purposes ?

Holland, against the weight of whose imports many in Britain have made vigorous protests, will say to us :—

" We can produce tomatoes more cheaply and efficiently than you —and earlier. We have more glass, plenty of labour and natural irrigation ; and even when your Customs fine us 2d. on each lb. we export during the summer, we can still undersell you. On the other hand, yours is a wonderful country for apples—no one can beat the British dessert apple. You concentrate on that ; let us grow the tomatoes."

This may be a hypothetical argument whose facts and assertions are open to challenge, but there is sufficient grim truth in this to make the realistic grower who is not afraid to consider the future from an international point of view have his doubts.

Or take grapes. Belgium will say to us :

" We have arranged to integrate our coal and steel industries so that they complement one another, and do not wastefully compete behind tariff walls. You must also recognise that we can produce grapes more cheaply and earlier than you with your colder climate. Your own grapes have difficulty in competing with ours even when we have to pay 3d. on every lb. sold to you, or one-fifth of the market price.

" You concentrate on wheat growing, for which your climate and soil so well suit you ; leave the grapes to us " (and to Greece, or Italy, or France, where these arguments apply in greater force).

Then there are, for example, cherries, peaches and cauliflowers from Italy, lettuce from France, tomatoes from the Canaries (in the unlikely event of Spain joining the comity of nations) . . . . . .

It is not said that these countries have watertight cases, but it is pretty clear that once the present customs duty vanishes, as a European Customs Union implies, every grower who has sunk capital into growing projects which are based on the belief that his early forced produce will be protected against cheaply-produced foreign competitive crops, may find himself faced with a financial crisis.

True, he has received every encouragement from the Government—a measure of priority for glass in houses, lights and cloches, concessions of dearly-won coal for heating glasshouses, nationalised British Electricity Authority officers to " sell " soil warming apparatus—true, he has every reason to believe that the Government is encouraging that important aspect of horticulture which specialises in bringing

produce early to market while foreign stuff is banned or heavily taxed.

But this " Government " encouragement is that of the Ministry of Agriculture—and see how that important department has succeeded in protecting our broccoli, leek and onion growers this season in the face of what are deemed the overriding demands of trade pacts. Anyone looking at the Polish or Dutch trade agreements can see how we have felt bound, in the interests of machine tool and manufactured products, to accept loads of surplus vegetables and fruits.

Admittedly, the greatest protecting force so far has been not the import duties, but the seasonal restriction on imports. But how precarious that is (e.g., tomato imports from Holland last summer) !

If the pressure for reciprocal action of European countries, **who may have had to concede much in order that our basic industries will thrive, not suffer,** becomes stronger, growers here may well stand to lose those few vital days or weeks at the beginning of a crop's season during which their forced produce exclusively sells on the home market.

Even to-day French producers, faced with a glut, are demanding an active export policy to save them from ruin. Can we expect France to absorb our machinery while we turn down her lettuces ?

All over Europe production is increasing, while the tendency has been for home consumption to remain steady. Sooner or later the British producer will feel the effect ; he is only just beginning to sense it now.

MODERN MUSHROOM FARMS—

THE BLANDFORD MUSHROOM FARM, DORSET, where Brigadier A. S. G. Douglas, C.B.E., grows. Manager is McGregor Bulloch, a frequent contributor to the M.G.A. Bulletin and an artistic photographer, as this picture demonstrates.

EXTRACTS FROM A MUSHROOM GROWER'S ★ DIARY ★

September 6. I hear of more and more growers who have difficulty getting crops to start in this continuous hot weather. It seems to be largely a ventilation problem or perhaps one of bad circulation caused through insufficient temperature difference between inside and outside, though unseen causes in the shape of mite, competing fungi, etc., may be responsible.

September 7. Heard at our Executive meeting. Mr. Atkins : " You need an adult mind to capture the subtleties in the study of mushroom growing." Someone asked how adult. " Probably over 30 "—he replied. A member : " Give me a factory with no subtleties. Tomato baskets can be turned out at 90 a minute, a million in 4½ five-day weeks." Another member (during a grading discussion where only buttons and cups were defined, flats presenting difficulties): " Obviously cups and *saucers* . . . . . " The Chairman intervened—" Gentlemen, we need an adult mind ! . . . . . "

September 9. The prolonged hot weather is tending to make growers think of cold rooms. While these would undoubtedly help to even out deliveries during spate production, there seems to be much doubt about the keeping qualities of cooled mushrooms. Little would be gained if semi-frozen stuff fetched low prices because of rapid decomposition on exposure to fresh air.

September 12. A French grower visiting the M.G.A. suddenly remembered that he had left his car on the quay in France. He used the Association's telephone to ask his wife to move it !

September 14. The fearful prognostications of the met. experts, now being vociferously and ubiquitously reported, that we are to " enjoy " this kind of weather for the next 30 years sound a most disquieting note. Reports from all over the country tell of growers suffering badly from three main troubles :—(1) Failure of crops to come into production. (2) Truffle rapidly building up. (3) Verticillium spreading apace. But times and tastes change. Who knows—in 30 years truffle may sell easily at 30/- per oz.

September 16. Thank goodness the weather has changed. Day temperatures down by 20° F. or more. The main lesson of the past months for Handcraft Hut growers is that these houses when efficiently insulated are quite inadequately ventilated for such weather. Compare 3 sq. ft. of top ventilator openings in Handcrafts (including gable vents) for 1,000 sq. ft., with 30 sq. ft. in American type houses for 2,000 sq. ft. of bed space. It is surely of *some* importance.

September 27. Multum in parvo. " Get the compost right and all is well." £5 reward for the lost secret.

September 30. A house underwent a secondary heat up after spawning with a curious consequential effect after casing. A few weak pinheads appeared but were so insecurely attached to their meagre threads that a puff was almost enough to blow them down. Soil was removed—the growth in it being quite improper for mushroom production—and the compost surface watered in several successive days. Within a week pinheads were forming all over the compost surface. We quickly recased leaving a section uncovered for interest. On that section pinheads have developed into perfectly formed heavy mushrooms and there is no sign of dying off anywhere in it.

October 5. If a house is not more than adequately ventilated where solid concrete beds are used, lack of air movement within the compost may be a cause of poor cropping in a sultry or airless summer.

October 7. A German student expressed a wish to see my mushroom " Plantation." In Germany, he says, the French word Champignon is gradually being narrowed down to mean only the white cultivated mushroom. " If a fungus has lines—how do you say, gills—we eat it. . . . . The old women have a science made of getting feelt funguses. They know when and where to get them and we cannot know . . . . . "

October 16. " Mushrooms " turned out to be the answer to a crossword clue—" Food free for all." Well, almost !

October 20. I shall always envy the growers (few in number surely) who seem able to guarantee an almost monotonously even daily production. I shall never know how they do it (will they themselves ?) I am not thinking of the Cave men, the " miners "—whose underground conditions give them a humidity and temperature constancy—but rather the " opencast " people who have to battle against the upper air.

October 25. A friend within 20 miles of London tells me he has picked nearly 100 lbs. this summer off his small lawn.

November 8. What *is* the ideal bed/air space ratio ? A small house averaging per crop 0·7 for 700 sq. ft. now averages 1·7 since the area was reduced to 500 sq. ft. Further, is there an ideal air space/bed space/ventilation space ratio ?

November 9. I cannot reconcile the above marked improvement (after increasing the air space) with the tray system. I have seen 2,000 sq. ft. of tray area in a house capable of only 1,000 sq. ft. on shelves. This represents a big reduction of air in the air/bed ratio, yet with apparently no serious consequences. But all my observations, and those of some higher and brainier authorities than I, tend to show that we should have *more* air, not *less*. What is the answer ? Is it the shallower compost in trays ? Is it shorter cropping period ? Is their better air circulation with trays ? Or are tray growers " in for a packet " if they get disease ?

November 12. Staggered to learn that on a " gentle zephyr " day in mid-October readings of air movement in my Handcraft Huts worked out at 0·6 change of air per hour.

November 14. For some time now I have used the so-called " Sinden method " of composting with very mixed results. The Doctor told me to expect this. Keeping the small stacks moist this last summer has been difficult. Now the weather has settled to " rain " the opposite is the case—they get too wet even with half the summer water added at the first turn. Also I'm having difficulty getting a final fermentation in the house. Some heat properly, but some won't even when put in earlier and boosted heavily.

November 22. Prices up, production down. Is it ever to be so ?

November 23. Verticillium is still too prevalent despite six weeks of cooler weather. How easy it is to contract and how long it stays after we think optimum conditions have passed.

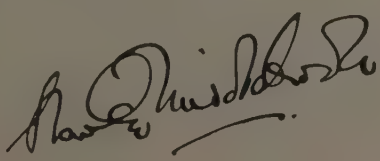
November 25. As a member of the Editorial Board of this Bulletin I have a pre-view of each issue, so to avoid waiting three months I can now comment on Bulloch's reply (see Correspondence) to my earlier comment on his article (Bulletin 16). I stick to my view that it would take years even with the most accurate instrument to find out correct, that is desirable, readings. In view of his statement in this issue it is clear I must give up mushroom growing. If it pleases the Editor I shall then be better qualified to write these Diary notes.

Also, as a result of the above-mentioned privilege, I would like to tell those who by accident read these diary notes first, assume the rest of the book to be on the same low level and therefore push it aside, that this issue seems to me perhaps the best ever sent out. Read it all. Gradually it is becoming more and more practical. There is scarcely an article here that the average grower (like yours truly) cannot get his teeth into and feed on. There is a mine of information herein. (It looks as though I am mixing them again—metaphors, I mean—not drinks !)

I thoroughly approve the idea of a series of farm photographs and a quarterly " How I grow." Better if the two were combined ?

November 29. While travelling I amused myself looking at London's Theatre and Cinema Guide. I couldn't help thinking how appropriate were some of the titles to mushroom growing :

Mummy disease—"*Tough at the Top*" ; when prices are high—" *Treasure Hunt*" ; first Bubble, second Verticillium, then Truffle—" *The Third Visitor*" ; August Bank Holiday—" *The Big Show of 1949*" ; reward for paying consistently low prices—" *Death of a Salesman*" ; the sciarid maggot looks up into the dome of a mushroom—" *Worm's Eye View*" ; any successful mushroom grower—" *Master of Arts*" ; the good old firefang—" *White Heat*" ; that illusive first pinhead—" *The Search*" ; phorids and gammexane—" *Crime and Punishment*" ; blame the spawn :—" *Everybody Does It.*"



A New Mushroom Disease

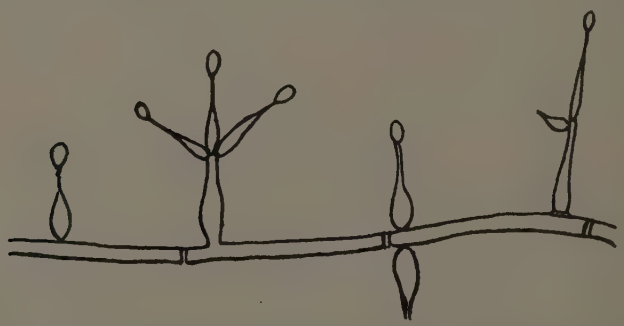
Preliminary Notes from McG. Bulloch on a Parasitic Fungus Disease of the Cultivated Mushroom

A hitherto unrecorded parasite on the cultivated mushroom, *Psalliota sp.*, was first observed by the writer in the summer of 1948, on mushroom beds in Kent and, on a number of occasions since, in Dorset.

On account of its great superficial resemblance to the well-known *Verticillium spp.*, and the fact that it is as virulent if not more so, it is obvious that, in the past, the new disease has been assumed to be *V. malthousei* or *V. psalliotae* whenever it has appeared.

The disease, which from its characteristics is provisionally regarded as an *Acremonium sp.*, spreads with great rapidity where humid conditions prevail, but good control has been effected by spraying the beds (including healthy as well as diseased mushrooms) with a 0·1% solution of sodium hypochlorite (10% w/v available chlorine). At this concentration, hardly any discoloration of tissue is evident and, if sprayed in time, **it is possible to eliminate the disease entirely** before the succeeding flush breaks through.

On healthy mushrooms, the fungus produces patches of varying diameters, of a deep chocolate brown colour, with a thin, close layer of mycelium. Occasionally hardly any trace of conidiophores or conidia is evident. On weak spongy tissue, colonies form white hemispherical close tufts with copious conidial growth, the affected patches being of a light tan colour before the onset of the disease. The cap of the mushroom is frequently covered with uniformly spaced tufts of a similar size.



Under the microscope, the fungus is seen to have a fine mycelium, septate, with erect, generally simple but occasionally branched conidiophores borne on all parts of the hyphae. As far as can be ascertained, the conidia are borne singly at the tips of the conidiophores or their branches. The single conidiophores are bulbous near the hyphae, tapering off to a fine point of attachment of the conidium. The accompanying sketch should enable growers to identify the disease without much trouble.

For those who are interested a fuller technical description of the parasite is being prepared for publication elsewhere.

Reproduced from "The Grower" (5 & 12.11.49) by courtesy of the Editor

MODERN METHODS OF GROWING MUSHROOMS

The third of the private discussions organised by the Editorial Board of *The Grower* was held recently in Worthing and dealt with modern trends in mushroom growing. Mr. A. De B. Hovell, Chairman of the West Sussex N.F.U. Horticultural Section, took the chair and those taking part included Mr. F. C. Atkins (Yaxley, Peterborough); Mr. H. G. Boxall (West Sussex); Capt. G. P. Lawrence (Hampshire); Dr. R. L. Edwards (Mushroom Research Association); Mr. H. H. Glasscock (Advisory Plant Pathologist, N.A.A.S., South-Eastern Province); Mr. V. Brautigam (Broome & Green); Mr. J. L. Kessler (West Sussex); Mr. R. Gardner (N.A.A.S., West Sussex).

The first subject dealt with was composting.

Hovell : The first essential for a good crop of mushrooms is to compost the manure properly. Will Capt. Lawrence tell us what he does?

Lawrence : We give four turns at weekly intervals, that is five periods of one week.

NO DEFINITE RULES

Hovell : Our procedure is similar, but we may cut down the last period. Sometimes we have given the last turn two days after the previous one. What do you do Atkins?

Atkins : We shan't get anywhere until we control environment—that is, all the physical conditions surrounding the compost. It is impossible to lay down definite rules. We find that by turning once a week and finishing off in the house, we get a fairly reliable product.

Glasscock : Does it not depend on the quality of the manure? A sample with a large number of droppings would hardly need so much time between the turnings.

Atkins : Yes, the heavier the manure the shorter the intervals, but we stick to seven days all the same.

Kessler : We leave six days between stacking and the first turn and then cut down to five days and four days. We once tried a quick turn method, turning every three days; the compost broke down well.

Boxall : We are also inclined to cut down the period.

Hovell : Environment is all important. What do you think, Dr. Edwards?

Edwards : Most growers develop their own methods to suit the type of manure they are getting. The shape of the stack is important. A large stack soon becomes anaerobic (lacks air) in the middle and the middle does not rot properly.

Kessler : We cut down the size of the stack, making each one narrower and higher than the one before. We put tile drains underneath to let the air in.

Glasscock : Little is known about bacterial action in the heap. All we do know is that if there is not enough air in the middle the manure doesn't rot properly and it won't grow mushrooms.

Hovell : The next thing is what do we add to the manure in compost ? If the manure is very strawy we use an activator to break it down more quickly.

Boxall : We always put in 1 cwt. of activator to 5 tons at the second turn. Our manure is fairly consistent because we always get it from the same stable.

Edwards : The main point of using activators is to put in extra nitrogen.

ACTION OF GYPSUM

Glasscock : Gypsum is also valuable. Dr. Pizer showed that many failures are associated with a greasy compost. He tried several substances that would flocculate the compost as lime does but without altering the pH. He found Gypsum the best substance to use. It gives the compost a flaky, crumbly structure. It should be applied at the stacking of the first heap.

Edwards : By applying Gypsum in the first heap it is more evenly mixed by the time the last turning is made. Even if you have respectable compost the addition of Gypsum gives an earlier crop by making the spawn run quicker.

Glasscock : The usual application is 28 lb. of Gypsum to each ton of compost. This is three or four times as much as is necessary but it does no harm and allows for uneven distribution.

Edwards : Some growers add superphosphate at the end of the composting. Is this really necessary ?

SOMETIMES HARMFUL

Glasscock : Most samples of manure do not need superphosphate and in some cases the addition is actually harmful. Therefore taking it on the whole it is safer not to add superphosphate at all.

Edwards : Superphosphate added in the start of composting may do harm, but added at the end it may be beneficial.

Atkins : Why ?

Edwards : I don't know.

Atkins : The Americans do it almost universally.

Gardner : Is the ill effect of phosphate that it makes the bed acid ?

Glasscock : We found adding phosphate has no effect on the pH.

Hovell : Should one add D.D.T. or Benzene hexachloride to the manure ? We have tried D.D.T. but the results are debatable. Benzene hexachloride we find valuable but we are wondering if it can taint the mushrooms. We mix it with the manure at 1 lb. to the ton.

Edwards : There is no danger at 2 lb. to the ton. Why not put it on top of the beds immediately before you peak heat ? The heat will drive mites and springtails to the surface where the Benzene hexachloride or D.D.T. is waiting for them.

Glasscock : Does not the peak heat kill the insects ?

Atkins : Mites and springtails survive 130° F. in the beds. They simply move out of the compost if it gets too hot for them.

Boxall : How much Benzene hexachloride do you dust on the beds ?

Edwards : About 2 or 3 lb. to each 1,000 sq. ft. of surface. The surface looks greyish. You can just about see that the bed has been dusted.

PEAK HEATING

Mr. Hovell explained the history of peak heating. Worthing growers before the war used to take their manure heaps inside the houses for the final turning, and they found that the places where the heaps had been produced the biggest crop of mushrooms. Why this should be so was a puzzle. By sticking their thermometers into the ground they found that these places where the heaps had stood were warmer than elsewhere. That was the beginning of peak heating.

Since then growers have heated the beds after they were laid, using pipe heat or any other means of heat available. They found that they got the best results if they heated the beds up to 120° F.

Kessler : I believe one Worthing grower is experimenting with flanged pipes laid along-side the heaps for 24 hours after the last turning, so that the manure is heated right through. It is covered with a tarpaulin.

Edwards : But it is necessary to get air into the stack and will you get air in if you cover it with tarpaulins ? In the beds themselves air can get to all parts because they are not very thick or wide.

Kessler : The greatest benefit of peak heating is the elimination of verdigris.

PRODUCTION INCREASED

Atkins : But production goes up remarkably. We started peak heating for 12 hours to reach 120° to 130° F. and production went up 20 per cent. at once.

Edwards : Peak heating does improve the cropping power of beds and it is also useful against some diseases. With B.H.C. it is useful against many pests.

Boxall : I understand the peak heating drives the pests to the surface where they can be dealt with by D.D.T., etc.

Glasscock : Before the war it was agreed in Worthing that peak heating improved the weight of crop but its main purpose was to drive the insects up to the surface.

Procter (Assistant Editor of *The Grower*)*:* I am told that it tends to dry the compost.

Edwards : Yes, but that you can control.

Boxall : After peak heating should you reduce the temperature quickly or slowly to spawning level ?

Atkins : If your compost is on the wet side you should reduce the temperature slowly, and vice versa.

Hovell : Now we come to spawning. We put down our pieces of spawn about 9 ins. apart. A quart carton does 45 sq. ft. I like to get the beds down to 80° F. for spawning.

Atkins : Yes, we spawn at 75°—80° F. unless we have had truffle trouble . . . . In this case we spawn at 65° F. This temperature is just too low for truffle to develop.

Glasscock : Truffle spores need acid conditions to germinate. It is believed that spawning makes the compost acid enough. But acid spots in the manure may also cause truffle.

SPAWNING DISTANCE

Glasscock : Moist spawn gives a crop two or three days earlier than dry spawn. You will also find that the poorer the compost the bigger the lump of spawn required.

Atkins : Yes, we follow that technique but do not know why poor compost should need larger lumps.

Glasscock : Mycelium runs better and faster with good quality compost. The large lump has more reserves of nutrients to start it off in poor compost.

Atkins : Last summer we tried putting the lumps 18 ins. apart and it made no difference to the final crop. In places where the spawn did not run together quickly the mushrooms were slower coming through, but that was all. The temperature of the bed was not affected.

Boxall : We put our spawn deeper in the summer to keep it moister.

Kessler : Couldn't you simply lay the lumps of spawn on the surface of the compost and cover with paper to prevent it drying out?

Atkins : We tried that, using foil. But the spawn was slow to develop. It needs air.

Kessler : At what temperature should one keep the house when the spawn is running? We ourselves prefer 70° F. but it may be too high.

Lawrence : We put in our spawn when the temperature is 75°—80° F. and hold it at 70° F. for three or four weeks.

Hovell : We hold it at 70° F. for two weeks and then don't allow the temperature to fall below 63° F.

Kessler : After you have put on the casing soil the temperature sometimes goes over 70° F. Isn't that dangerous?

Glasscock : Yes, casing soil increases the heat. I have heard of the temperature rising and killing the spawn. That is why we advise spawning at 70° F. **on the down run** for beginners. Experienced growers, of course, can go to 75° F.

PEST CONTROL

Gardner : Does the thickness of the casing soil affect the temperature?

Glasscock : No, I don't think so.

Boxall : Directly we have spawned we put D.D.T. on the compost fairly liberally, before casing. This acts as a barrier against flies.

Hovell : We used to water with nicotine at one oz. in five gallons but water at this stage may be harmful.

Glasscock : Yes, it stimulates the growth of moulds.

Edwards : We have found with synthetic composts that even a light spray between spawning and casing reduces the crop.

Boxall : I think this is frequently done in this area, although I disagree with it.

Atkins : It is an almost universal practice.

Kessler : In glasshouses, but not in sheds, we have found a single sheet of brown paper over the spawned beds to be beneficial. We have used straw covering in sheds in very cold weather. We got a good crop but a lot of mould.

CASING SOIL

Hovell : We find that the brick earth below the top soil in this Worthing area grows mushrooms very well. We use the soil two feet to six feet below the surface and add limestone at 15 lb. to a cubic yard.

Atkins : I think that almost any soil will grow mushrooms if it is given proper treatment ; if it is given water, for instance, appropriate to its particular texture. Research on this subject leaves me cold. Dr. Pizer found variations in the results obtained from different casing soils but he did not vary sufficiently the treatment of the soils. Every soil needs its own treatment.

Lawrence : We use the thin top soil over chalk for casing and it suits us. We have even got a crop using pure chalk, though not a very good crop.

Glasscock : I suggest there is more to it than treatment of the soil. You can have two apparently identical soils, but still one will produce a good crop and the other a bad crop. Again if you put a layer of good soil on top of a layer of bad soil you get a crop. But if you put the bad soil on top of the good soil you don't get a crop.

We have grown mushrooms with a pure sand casing. This suggests that some casing soils have an inhibitory effect on button production. Some soils will not grow mushrooms whatever treatment you give them.

Some soils will produce plenty of mycelium but a poor crop. Others will produce a good crop with little mycelium. Sometimes a good soil fails to give a crop after it has been sterilised.

Edwards : Isn't failure of a soil to produce mushrooms due to physical defects rather than to biological ones ?

Glasscock : That may be so but the fact that you can get buttons in pure sand suggests an inhibitor.

Hovell : Why do we go below two feet to get our casing soil ? Isn't it because the soil there is free from pests ?

Kessler : Yes, that is the reason.

Atkins : Do you sterilise ?

Kessler : No, it's not necessary; also sterilising makes our soil difficult to wet.

STERILISING

Glasscock : Sterilising may be more important for the all-the-year-round grower than for the winter glasshouse grower. *Mycogone* is more rampant in hot weather. Most growers agree that it is better not to sterilise if you can avoid it.

Kessler : We are now trying formaldehyde for sterilising the casing soil. We water it on and then run a rotary hoe through.

Atkins : Is that better than heaping the casing soil in layers and sprinkling formaldehyde on each layer.

Kessler : That may make the soil too wet.

Glasscock : The gas is the active agent in formaldehyde. Why not use it at double strength (4 per cent.) and half the quantity ?

Atkins : The Americans use it at 10 per cent.

Boxall : We find that if we put the casing soil on wet, we pick two weeks earlier than if we water the soil after it is put on. But this does not mean a shorter cropping life for the beds. We still get twenty-one weeks between filling and clearing out the crop.

Edwards : Some growers use peat to prevent the casing soil drying out too soon, or ashes if the casing soil needs making lighter.

Glasscock : Casing soil is of vital importance, there is no doubt about that. Truffle is introduced with the casing soil. When putting on casing soil you should leave at least one strip of the bed and cover that strip with the casing soil you intend to use for the next crop. This will enable you to see if your next casing soil is going to work.

Hovell : How soon after spawning do you put on the casing soil ?

Atkins : We case ten days after spawning if the compost is dry and up to twenty-one days if it is wet.

Boxall : We give it a fortnight.

Lawrence : Two or three weeks or, if it is wet, up to a month.

Edwards : I'd say up to four weeks.

Glasscock : A fortnight unless the compost is wet.

Kessler : Two or three weeks normally, up to a month if wet.

Hovell : We wait only seven to ten days at the most. I am certain that the spawn runs into the casing soil and that is where you want it. I have a bed now that began cropping thirty-two days from spawning. That bed was cased only four days after spawning.

Atkins : One thing that has struck me about recent developments is the tendency to use lumpier casing soil.

Hovell : Yes, indeed, and it is laid on loosely too. Do you remember how we used to bash the soil down with a spade ?

GRADING

We cannot finish without a few remarks from Brautigam on picking and grading.

Brautigam : The first few mushrooms from a new bed are usually big and awkward, and therefore difficult to sort.

The National Mark did much to establish grades for mushrooms ; but its insistence on uniformity of size in each chip proved to be unnecessary and was an embarrassment to the salesman, who sometimes had to sort the parcel to find what his customer wanted.

Modern requirements are met by a tight button ranging from $1\frac{1}{4}$ in. to $1\frac{3}{4}$ in. in diameter, a cup of from $1\frac{3}{4}$ in. to $2\frac{1}{2}$ in., and opens of from 2 in. to 3 in. All other mushrooms, whether open or closed, can broadly be graded as " large " or " small." Stems should be trimmed to about $\frac{1}{4}$ in.—not flush with the mushroom—and packed separately.

When contemplating the significance of plant disease one can scarely fail to be impressed by what appears to be a marked difference in the response of the producer to problems of **disease.** Though there are exceptions, it seems fairly obvious—and is perhaps only to be expected—that with crops having a relatively low value per unit area, the application of advances in plant pathology usually comes about as a result of encouragement or pressure from without, whereas with crops having a relatively high value per unit area it is the producer who applies the pressure and is impatient for fresh knowledge. It by no means follows, therefore, that the producer, the plant pathologist, and the economist, see eye to eye on the importance of disease.

W. C. Moore, in his address as President of the Association of Applied Biologists. (*Annals of Applied Biology*, September, 1949.)

Water Changes in Mushroom Beds

By

S. BURROWS, M.R.A. Chemist

A knowledge of the changes which are likely to take place in the water in mushroom beds and the causes of those changes should be of some help in the intelligent application of water during cropping. The grower's problem is to be able to judge when the correct amount of water is present in both compost and soil and also how to maintain that ideal condition as far as possible. The factors which produce variations in moisture are therefore worthy of consideration.

Obviously the main cause of mushroom beds acquiring moisture is the operation of watering itself, but there is also the minor one of condensation when a humid house cools down at night. Water losses are due to evaporation from the soil, the compost if any is exposed through cracks in the shelving, and the mushroom cap. This latter is called transpiration. No information on the relative importance of these different factors is available but it is probable that a good crop will transpire more water than a poor one and this may be manifested by a more rapid drying of the casing soil.

Both evaporation and transpiration losses will depend not only upon the temperature and the amount of water in the air of the house but also upon the amount of water in the surfaces where evaporation is taking place. A damp soil will loose water more rapidly than a dry soil and both will loose it more rapidly to dry air than moist air.

All this is rather elementary, but it illustrates the general rule that things tend to go downhill. Water tries to move down a humidity gradient, that is, from a place where there is more of it to where there is less, so endeavouring to even things up. This principle also governs the movement of water inside the mushroom beds. Loss of water at the surface already referred to causes water from the moister layers underneath to move up and this process goes on throughout the depth of the bed causing a continual upward movement of water, the rate of which seems to depend upon the amount of water in the compost. Thus upward movement takes place partly in the strands of mycelium in the compost and soil and partly in the compost and soil itself, although the former effect is probably predominant and may be speeded up by the activity of the mushroom itself, the energy for this effort being derived from the breakdown of food material in the compost.

In this manner water is continually being lost from the compost to the casing soil and the surrounding air and the amount lost is surprisingly large. At Yaxley it was calculated that in a bed of heavy horse manure compost an amount equal to about two-thirds of that originally present was lost from the compost between filling and emptying, apart from the much larger amount which must have been watered on to the soil and which also evaporated. Synthetic composts seem to lose a somewhat lower proportion of their water (about 55 to 60%).

The alert reader may suspect that our arithmetic is faulty since the percentage of moisture in the average compost only drops from about 65% to about 50% or from 200% to 100% if the figures are based on the

dry compost and not on the total moist compost. In order to vindicate our doubtful arithmetical honour we will digress for a moment into the field of physiology. Mushrooms, in common with other organisms called saprophytes, feed mainly upon carbohydrates and break them down into simpler compounds in order to obtain energy for growth and development. The final products of this break down are carbon dioxide and water and in order to reach this stage, oxygen from the air must be used in a manner which reminds us of the controlled burning of petrol-air mixtures producing energy for driving a car. A mushroom compost contains a high proportion of carbohydrates, of which between a third and a half may be consumed by the mushroom and other organisms in the compost. The water formed amounts to about half of the weight of dry compost consumed and also the water left forms a higher percentage of the compost remaining since there is now less of it. In order to make this clear we shall take an easy example of, say, a heavy horse-manure compost in one square foot of bed.

						lb.
Weight of dry compost	....	....	....			9
Weight of water in compost (66·7% of fresh compost)						18
Loss of dry compost between filling and emptying	=	$\frac{1}{3}$	of	9	=	3
Water formed from this	....	....	=	$\frac{1}{2}$	of 3	= $1\frac{1}{2}$
Water originally present + water formed		=	18	+	$1\frac{1}{2}$	= $19\frac{1}{2}$
Dry matter in spent compost	....	=	9	—	3	= 6
Water in spent compost (say 50%)						6
Water lost	....	....	....	....	= $19\frac{1}{2}$ — 6	= $13\frac{1}{2}$

In this purely hypothetical example the water lost amounts to over two-thirds of that originally present, the smaller change in the percentage figures being due to the biological formation of water from hydrogen in the carbohydrates of the compost and to a decrease in the amount of compost present tending to increase the proportion of water.

It is usually taken for granted that a continuous decrease in the percentage of moisture in a compost will take place due to evaporation at the soil surface and upward movement of water in the bed, but the example above shows that the possibility of an increase in moisture content cannot be entirely ruled out under adverse conditions. The bottom layers of compost would be most subject to this since it is here that the upward movement of water is slowest and if the beds were laid on concrete or other impervious material no loss of water would occur in a downward direction ; however, the most important factor in tending to produce an increase in moisture content would probably be a poor casing soil which supported little mycelial growth thus hindering upward transport of water.

In caves and mines where the humidity is generally high the loss of water by purely physical evaporation must be a good deal smaller than it is in a mushroom house. A somewhat drier compost and a shallower layer of casing soil may be used to allow for this but it is quite probable that under humid conditions the mushroom is still able to transpire water. The " down-hill rule " would then be broken, the mushroom expending energy in pushing water up-hill against a humidity gradient or in speeding up its movement down a very gentle gradient.

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★

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Fred. C. Atkins thinking aloud .....

"FIRST THURSDAYS"

In the Spring of last year, Secretary Watson and I were overwhelmed by the unco-ordinated arrival of 37 visitors during the course of one week. Between us we probably did one day's work between the Monday and the Friday. It simply could not be allowed to continue, so we decided to ask growers to confine their visits as far as they could to the first Thursdays of each month. To rescue Dr. Edwards from the same predicament we asked him to do the same.

It *seemed* regrettable, but the experiment at once proved unexpectedly successful. Growers coming to talk over a problem with any one of us now had the advantage of being able to discuss it with all three of us—and with the other growers who happen to be present on that day. The 60 odd who have come along so far have all gone away full of appreciation.

Let me just describe a typical occasion. There were 10 of us, which is a convenient number—we all have a chance to answer each other's questions. One visitor was a potential grower with capital behind him. He wanted to build a really good mushroom farm, and produced architect's plans ; would we criticise ? We did so. We pointed out that his layout would make ventilation very tricky, urged him to start on a smaller scale, and suggested a better position for his composting shed. Little points, perhaps—but how else could he get this disinterested advice from a representative cross-section of growers ?

One grower told us he wished to try Bordeaux Mixture on beds attacked by *Verticillium.* He said he knew Bordeaux Mixture was made up of copper sulphate, lime and water ; but was he correct in assuming the 1 : 1 : 50 referred to the ration of these ingredients ? We were able to tell him that the ration was 1 lb. copper sulphate : 1 lb. quicklime : 1 gallon water. He had assumed all the figures referred to pounds weight, which was reasonable enough. We were sympathetic. Why isn't this ratio " rationalized ?" Why not 1 : 1 : 500 (parts by weight) ?

Another grower had attended an earlier first Thursday, terribly worried about a serious attack of mites and springtails. We had suggested H.E.T.P. or Gammexane. He had tried H.E.T.P. liquid on some beds, Gammexane dust on others, and both on the remainder. He had come along on this occasion to tell us how he fared. Spraying every other day for a week with H.E.T.P. had been most successful at a dilution of 1 : 400. A light dusting of Agrocide 3 (Gammexane) had been reasonably satisfactory, but we had not been able to give him a precise dosage, and he felt a heavier dusting might have done the trick. Two beds totalling 100 sq. ft. he had first dusted with Gammexane and, three days later, sprayed with H.E.T.P. ; from this area he had picked in a month only about half a dozen gigantic mushrooms. All the other beds cropped normally. What had gone wrong ? We could not tell him—but we had all learnt that H.E.P T., and perhaps Gammexane, were worthwhile additions to our mite-and-springtail control armoury.

MY WAY OF GROWING

1.—T. ORRITT, of BURSCOUGH BRIDGE, LANCS.

(Mr. Orritt's article on his way of growing is the first of a series which the Editorial Board feels will go a long way towards answering the appeal by many growers for more practical advice. It is hoped that others will follow Mr. Orritt's lead and explain to their fellow-members how they are solving their problems. This is mutual aid in earnest.)

I would like to explain that I am only a "rookie" in the mushroom industry. I was demobbed from the Army in 1945, after getting away from Dunkirk, then sailing for Malaya, and unfortunately being taken prisoner at Singapore and working three years on the Death Railway in Siam. I came home looking for something interesting, with a fair amount of work, so that my mind could be fairly well kept busy, and I may add that I have certainly found what I was looking for in the business of cultivating mushrooms.

I started off in a two-storey brick outbuilding on the shelf system, having 1,000 sq. ft. of bed on each floor and fortunately hit lucky, my first crop averaging 1½ lbs. per sq. ft.

I continued with this system until I read Dr. Sinden's article in No. 9 Bulletin, then my interest in shelves ended. I could see immediately that this was something I had been looking for, a much more mobile method of cultivating mushrooms, and I have now completely changed over from shelves to trays, which is what I am going to write about. I might say here that my production houses are now three Railway Arches, 35 ft. long, 15 ft. wide and 7 ft. high.

My first problem was, of course, how to obtain a suitable tray, and I experimented with all sorts of material before deciding on the following wooden trays with galvanised sheet metal bottoms, size 2′ 6″ × 2′, ends 6″, sides 5″, all ¾″ timber, which I bought from a Sawmill without permit, under the heading of Agricultural crates, seed boxes, etc.; these frames were nailed together and delivered, at 3/- per frame. I also bought 6 ft. × 2 ft. 6ins. × 26g. flat galvanised sheet metal, without permit, in quantities of 5 cwt. per month. These cut in 3 and made 3 tray bottoms without any waste, nailed to the frames, the result is a good, strong, light portable tray. I now can easily carry these with 4 in. of manure in; 2 men are needed when cased. The frames are creosoted and the metal painted with bitumen black. The galvanised sheets cost 5/2½ each. Complete tray 5/-, giving 5 sq. ft. of bed area. I have now 800 and 200 boxes, or 1,000 sq. ft. in each production room, and 200 spare which are in the steam room and ready for when the 1st production room finishes cropping.

I, of course, had to buy a steam boiler and I made a temporary steam-room on the ground floor of the outbuilding. I have recently had plans passed to have a new one built. The steam boiler is also used for sterilizing my soil.

COMPOSTING. I use 5 tons of horse manure for every 1,000 sq. ft. and compost in the usual manner, 3 or 4 turns at weekly intervals. I have composted one load with the indoor composting method, using live steam, which turned out very satisfactory and I "picked" the first

mushrooms from this 7 weeks and 3 days after the manure being unloaded in the yard. Unfortunately my temporary steam room would not stand continuing this method. I am of the opinion that with a specially built steam room, the hard way of outdoor composting would no longer be necessary with the tray system.

FILLING. The trays are stacked near the finished compost, and a table or bench is used to put the trays on for filling. One man forks the compost into the trays, 1 man levels the compost and firms it down to within 1 in. of the side boards, and 1 man carries the full trays of compost into the steam room and packs them immediately on top of each other, the ends of the trays being 1 in. higher than the sides, giving a 2 in. clearance between the top of the compost in one tray and the bottom of the next tray. Roller conveyors could of course be used to good advantage in conveying the trays from filling table to steam room.

PEAK HEAT. The steam boiler is started about half an hour before the last tray is in and gentle live steam allowed to pass in the room for the remainder of the day and the first night. The following morning early the steam is turned full on. Incidently the boiler is "fully automatic," unless you wish to stay up all night pumping water and stoking, etc. In my case at about 10 a.m. the temperature is around 130—135° and this is as high as I go and it is kept at that until 10 p.m., the compost being more often than not about 140° F. I then turn off the steam and open doors, windows, etc., to allow the whole place to cool down as quickly as possible; any delay in cooling down appears to dry out the compost too much. The following day is also allowed for the compost to cool down to spawning temperature and the following day spawning takes place.

SPAWNING. Moist spawn is used, and 2 men start at one end of the steam room and work through the trays, re-stacking them behind them when spawned. A "long low" steam room with a door at each end I think would be the most suitable; trays need then to be stacked only 9 or 10 high, and when spawning you can enter at one end and work through and leave at the other; width need only be sufficient to accommodate the trays so that no more space has got to be heated than necessary.

SPAWN RUNNING. The steam room is again closed tight and gentle steam to keep an air temperature of approximately 70° F. is maintained for 2 to 3 weeks, after which time you have no need to look under the compost to see if the spawn has run or not, there is simply one mass of spawn run all over the trays and very encouraging indeed it looks.

CASING. The trays are carried by 1 man from the steam room on to a table near the stack of soil, and approximately 1 in. of soil is put on making it level with the side boards. Then of course they could be placed straight into the production room, but unfortunately my growing houses are about $\frac{1}{4}$ mile away and I have to convey them there by lorry. Rollers again of course could be used for the above operation when the casing shed is near the growing houses.

CROPPING. Pinheads normally appear in the 2nd or 3rd week, but I have also had some very early crops, i.e., one crop spawned 4th October, 1948, cased 15th October, 1948, pinheads through 28th October,

1948, " 3 weeks 3 days." The following crop in the same house spawned 14th December, cased 31st December, pinheads 14th January, " 4 weeks 3 days." My crop average is 1 lb. per sq. ft. approximately in 8 weeks cropping.

EMPTYING. The trays are then carried out and emptied on to the manure contractors lorry. The house then appears almost as clean as when first filled. It is swept out and washed down with Formaldehyde and filled up again within the next few days with a new batch of trays. It will now be seen clearly why a spare set of trays is necessary. I would like to give you a few figures and prove that I can produce " twice the amount " of mushrooms per year, growing in trays than in tiers or shelves, in the same number of houses and with the same tonnage of manure

House size—35 ft. × 15 ft. × 7 ft.

Bed space available with shelves		750 sq. ft.
Bed space available with trays (200)		1,000 sq. ft.
Crop average on shelves @ 1½ lbs. sq. ft.		1,125 lbs.
2 crops per year		2,250 lbs.
3 Houses	Total	6,750 lbs.
Crop average on trays @ 1 lb. sq. ft.		1,000 lbs.
4 crops per year		4,000 lbs.
3 Houses	Total	12,000 lbs.

Manure used on shelves :—
12 tons per 750 sq. ft.
6 crops = 72 tons.

Manure used on trays :—
6 tons per 1,000 sq. ft. (maximum amount).
12 crops = 72 tons.

Another advantage is that one can usually get the manure for smaller stacks more easily than for larger stacks.

Well, there it is. I promised you this article. It has been a bit of a struggle finding time to get it together, as my father has been in hospital and I have not had many idle moments for writing. If any fellow-growers have any questions they would like to ask, I shall be only too glad to answer them through the Bulletin.

NEWS FROM AUSTRALIA

Mr. Norman Fell, of Sherburn-in-Elmet, Yorkshire, sends us an interesting letter he received recently from an Australian friend to whom he had sent some mushroom spawn in January. The friend writes : —

" You have certainly broken down the theory that spawn would not pass through the Red Sea and reach Australia alive. The brown is doing the best, but the cream and white are doing well. My compost was composed of 2 tons baled straw and 4 tons fowl manure, with 28

lb. gypsum added to each ton of the mixture. I turned the pile five times. When the pH was 7·8 I put it in boxes measuring 2 ft. long by 1 ft. wide. They did not heat up, although they had 10½ inches of compost in them. So I put them up to 70° F. by artificial heat and spawned them. The first mushrooms were picked 47 days after spawning. In the first four weeks the boxes had produced nearly ¾ lb. per sq. ft. I expect to get 1¾ lb. before they finish—at between 4/- and 5/- lb. (I once turned a box upside down, by the way, and picked another 1 lb. to the square foot from it !)

" Little headway is being made here in the field of synthetic composts, but I can get fowl manure at 20/- per ton ! I cannot quite understand why more growers in the Old Country (which is importing such huge quantities of poultry and eggs) do not build up a poultry farm and combine fowls with mushrooms. I claim that fowl manure is as good as others for mushroom compost. The mushrooms appear sooner, although they are smaller and lighter—but that may be partly my fault.

" Before composting a more recent pile I built a triangular frame between 2 ft. and 3 ft. wide at the base and 2 ft. high and stacked the compost over that, about 6 ft. 6 in. high. The pile is ready after four turns, and seems better than five turns without this core system of composting."

MEMBERS' ADVERTISEMENTS

We are requiring to buy a few lorry loads of Spent Mushroom Manure for us to collect, not too far away from Middlesex. E. J. Woodman & Sons, High Street, Pinner, Middlesex. Telephone : 802 (5 lines)

FOR SALE : –A modern freehold premises of 15 acres (8 arable for fruit, etc.), situated 6 miles from Bury St. Edmund's, 9 miles from Newmarket Stables. In use at present solely as a mushroom farm, but capable of expanding to a small canning station or frozen fruits. The buildings are ideal and unique, and form a compact and modern layout, comprising main frontage buildings of some 200 ft. × 20 ft., in brick, in use as packing rooms, stores, offices, etc. Behind this is a compact group of prefabricated concrete buildings 60 ft. × 20 ft. × 10 ft., metal windows with doors at each end. Three of these buildings are piped and heated. Several other buildings conveniently grouped, together with a prefabricated dwelling-house, in excellent repair, with french windows, bath, Raeburn cooker, etc., 12 rooms of good proportions. Main water, sanitation, etc., are laid on, most buildings wired for electricity, and the main which has just been erected will shortly be connected. The property has been approved by the Town and Country Planners as a canning station, and it is ideal for this purpose, or frozen fruits, intensive market gardening or solely mushroom cultivation, for which a good trade is being done at present. Further particulars on request from the owner, R. J. E. Buckingham, C.M.G. Mushrooms of Chedburgh, Bury St. Edmund's, Suffolk.

Dr. R. L. EDWARDS reports to the Mushroom Industry :

Developing a Synthetic Compost

2. NITROGEN & PHOSPHORUS REQUIREMENTS

Although Stoller published in 1943 a formula with optimum proportions of nitrogen, phosphorus and potassium to be used in mushroom composts, no details were given of the evidence on which his statement was based.

We therefore considered it necessary to investigate this question experimentally, and in view of Stoller's statement that the requirements for these elements are related, nitrogen and phosphorus were included in one experiment. It was not possible to include potassium owing to limitations of space.

An experiment was set up with three different proportions of nitrogen and two of phosphorus, making six treatments in all. Two stacks were made with each treatment. Pizer has reported that composts low in phosphorus can be improved by adding phosphate after composting ; it is also possible that the phosphate requirement for composting is different from that for mushroom production. Accordingly each of the twelve stacks was divided into two equal parts before making the beds, and an extra portion of superphosphate was added to one half, giving twelve treatments and twenty-four half-stacks. Each half-stack filled 3 beds.

Nitrogen was supplied as dried blood and phosphorus as superphosphate. Sulphate of potash, ground limestone, gypsum and trace elements were included in all composts.

The quantities of dried blood and phosphate shown in Table 1 were added per ton of wheat straw. There are slight differences in the quantities of superphosphate to allow for the phosphorus in the blood.

TABLE 1

	Dried blood	Superphosphate at stacking	filling
N_1P_1	110 lbs.	35	
N_1P_1+P	110	35	70
N_1P_2	110	105	
N_1P_2+P	110	105	70
N_2P_1	260	32	
N_2P_1+P	260	32	70
N_2P_2	260	102	
N_2P_2+P	260	102	70
N_3P_1	410	30	
N_3P_1+P	410	30	70
N_3P_2	410	100	
N_3P_2+P	410	100	70

By analysis of variance the effects due to nitrogen, to phosphorus, and to any effect of one on the other (interaction) can be determined. No interaction was found, and the results can be stated in their simplest form in Table 2, which gives the average values for all stacks and beds on the three nitrogen and four phosphate treatments. Yield figures are for 12 weeks picking.

TABLE 2

	N_1	N_2	N_3	P_1	P_1+P	P_2	P_2+P	
Max. compost temperature	135	142	147	140		144		°F.
Spawning-pinheads	72	52	49	59	50	57	63	days
Cropping life of beds	65	81	93	85	88	75	70	days
Mushrooms per sq. ft.	12	12	15	19	16	11	7	
Lbs. per sq. ft.	0·54	0·63	0·85	0·95	0·82	0·58	0·33	
Ozs. per mushroom	0·70	0·81	0·88	0·79	0·81	0·82	0·78	

Increasing the nitrogen gave an earlier crop which lasted longer. The effect on the number of mushrooms was not statistically significant but the total yield was significantly increased through an increase in size of the mushrooms on the high-N. composts.

Increasing the superphosphate reduced the number of mushrooms and the total yield. It is interesting to compare P_1+P and P_2, having equal total amounts of superphosphate. In all respects it is clear that adding half of the phosphate at filling was better than adding all of it at stacking, and this practice has been adopted.

It is still possible that a higher proportion of nitrogen and a lower one of phosphate, or splitting P_1 to add half of it at stacking and half at filling, might give better results. Further experiments will be needed to determine these points.

SUMMARY :

Increasing the dried blood from 110 lbs. to 410 lbs. per ton of straw gave an earlier and heavier crop and longer picking period.

Increasing the superphosphate from 35 lbs. to 105 lbs. or 175 lbs. per ton of straw reduced the yield and shortened the cropping life of the beds.

Adding 35 lbs. of superphosphate per ton of straw at stacking and 70 lbs. at filling was better in every way than adding 105 lbs. at stacking.

Mushroom Growing in Denmark

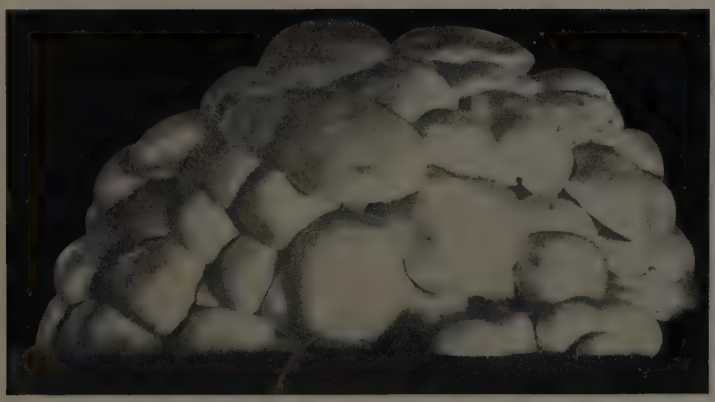
Mr. de Grevenkop-Castenskiold visited Yaxley recently and discussed with me his method of growing mushrooms in Denmark. He told me the manure position was similar to that in England : heavy manure from brewery stables and a lighter quality from racing, riding and army stables. Some stables fed molasses, silage or sugar beet to their horses, and a cold manure resulted which did not compost well. The heavy manure gave better crops.

Mushrooms are generally grown on shelf beds in houses. Mr. de

Grevenkop's own shelves have no sides so that the manure slopes up from the edge to a depth of about 12″ for most of the width. The shelves are 4-ft. wide, they are installed in old cow-sheds which hold about 6,000 sq. ft. each. Mushrooms are picked small, not exceeding 2″ diameter, tightly closed, and the soil and strands are brushed off but the stumps are not cut. The casing soil is similar in appearance to that at Yaxley, but contains rather less clay. If the mushrooms are open they are considered of very poor quality, and the housewife scrapes out the gills which are not eaten.

DDT has been widely used but flies are becoming resistant to it, and Gammexane is also used. Another pest is a midge; we did not identify the corresponding English insect. Mites also occur, and brown and white plaster moulds, only one of these is considered harmful, Mr. de Grevenkop was not sure which. *Verticillium* sometimes occurs. The average yield is $1\frac{1}{2}$ to $1\frac{3}{4}$ lbs. per sq. ft. They often fumigate with sulphur when the house is empty, and they normally peak-heat the house to about 120° F. Mr. de Grevenkop's houses are equipped with air conditioning in which the air is blown over steam pipes, and then through a chamber in which water is continually sprayed to form a fine mist. The temperature and humidity of the air are thus controlled, but the air cannot be cooled apart from the cooling effect of the spray. Temperatures go higher in summer and lower in winter than is usual in England.

Danish spawn is used; one consignment of English spawn gave a yield equal to the best Danish. R. L. E.



Mr. F. W. BATEMAN sends the above photograph of an astonishing clump of mushrooms grown at Homeland Nurseries, Bristol. The diameter of the cluster was 17 inches and the height $9\frac{1}{2}$ inches. There were 157 mushrooms, their weight totalling $4\frac{1}{2}$ lb. (This gives close on 3 lb. to the square foot!)

CORRESPONDENCE

QUIZ : Would it be considered worthwhile for all members who are troubled with unknown intruders of their mushroom beds to bring samples in safely sealed glass-top containers with them to the next M.G.A. Luncheon, put these on show and organise mutual exchange of identification and advice? HILARY N. BALL.

ARTIFICIAL : I had just arrived at the station to put some of my mushrooms on rail for market. A woman asked her friend : " What's in the baskets ?" The friend, reading cover : " Oh, they're mushrooms " —" Mushrooms ? I didn't think there were any this year."—" Oh, I think these are the artificial kind !" I suppose this is what comes of growing on synthetic compost ! R. H. T. GIBBENS.

WHAT HAPPENED ? Our fellow-growers have put forward many questions and they have been obligingly answered. What I would like to see is the growers who have benefited by the answers writing a few lines through the Bulletin in appreciation or otherwise of the information so willingly put forward. This would then give members some confirmation whether the advice proved successful or not, should the same problem arise on our own farms, and the least it could do would be to encourage further answers. T. ORRITT.

WAKE UP, ENGLAND ! I am sending you a tin of " sliced mushrooms braised in butter (nett weight 4 ounces)." This tin was exported by the Danish Mushroom Industry Ltd., of Copenhagen, to this country (Southern Rhodesia) where it retails at 4/5. That works out at 17/8 per lb. Have any growers at home considered exporting to us ?

CAPT. M. E. FEW.

EDITOR'S NOTE : The tin reached Yaxley safely. The contents were " heated slightly on a frying pan " as directed, and eaten on toast. They were buttons (closed, cap about 1" dia.) cut into $\frac{1}{8}$" thick slices. They provided a useful snack for one person. With bacon and egg there would have been sufficient for four people.

SOIL TENSIOMETER : In reply to the Diarist's valuable criticism, that the ' cup ' of the soil tensiometer would tend to give an average reading of the casing moisture, I quite agree. In point of fact, this " snag " was not mentioned, but was not overlooked, since, a few days after the article appeared, the manufacturers were approached with a view to substituting a sintered glass disc for the cup, so that a reading at any level could be obtained. I am quite sure that this would solve one of the most important problems, which is, having applied a certain weight of water, does it reach the junction of soil and compost ? If the sintered glass disc lies, say, $\frac{1}{4}$" above the compost surface, then if the gauge needle drops to zero fairly soon after watering, there is a sign that the water has reached the compost in too great a quantity, and so on. Regarding the assertion that it would take years to arrive at the correct readings, we must assume that the majority of mushroom growers enjoy the keenest of intelligences, otherwise they would do well to give up mushroom growing. McG. BULLOCH.

COSTING : Mr. Atkins suggests growers supply data to compare with his figures in "Counting the Cost." This encourages me to put forward the following considerations for the basis on which cost analyses should be made. Labour should be classified under :—(1) Picking, trashing and packing and (2) all other operations. This eliminates the variable and conflicting factor of yield ; all other operations are a constant incidence. Costs should be per ton of manure, and not per square foot or per pound of mushrooms. The advantages are obvious ; variable factors such as thickness of beds and character of manure yield are eliminated. LT.-COL. E. NOEL.

TRAY SYSTEM : You mention in your Editorial that the Tray System without mechanisation is more or less a wash-out. I very much wish to differ. My father (who is 60) and I are now producing twice the amount of mushrooms in a year, i.e., 22,000 lb., as we did in the same three houses with shelves. The only additions required were one steam room, one steam boiler, and the trays to replace the shelves—not an ounce of mechanisation around the place. We start work at 8 a.m., my father finishes at 4.30 and I at 5 p.m. Further proof, of course, is to be found in the most interesting article by Hildegarde Robertson, who produces mushrooms in quantity under what might be thought almost impossible conditions, claiming 2 lb. and sometimes 3 lb. per square foot. T. ORRITT.

GRADING : I feel that the proposals of your sub-committee on Grading call for some comment. They appear to be contrary to accepted practice and somewhat illogical. 1. *BUTTONS.* These are understood by most people to be small closed mushrooms of 1" in diameter or less. The term, so applied, is descriptive and sensible. 2. *CUPS.* These are normally understood to be closed mushrooms, exceeding 1" in diameter and up to about 2½". I agree that the name is perhaps not very descriptive, but is so generally accepted and understood that there seems to be no object in changing it for this grade of mushroom. 3. *FLATS.* Agreed as proposed. An intermediate grade, comprising cups that have just opened or begun to open, might be called "open cups." Some markets might react favourably to this distinction. The other point on which I would disagree is contained in paragraph 4 under Packs. It is useless to pack a basket carefully in layers as suggested and leave off 1" from the top. The net result will be a higgledy-piggledy mix up. Baskets should be filled level with the top so that the cover prevents undue movement. They will then arrive more or less as packed. I am, however, of the opinion that grading cannot be laid down, as requirements vary for different markets. The answer is to grade according to the wishes of your particular salesman, who is in the best position to judge. It then becomes merely a matter of liaison. COL. W. A. TURNER.

Additions to the Library : *The Fruit Grower Year Book*, 1950. *Mushroom News*, Vol. II, No. 3 (1949), presented by W. Darlington and Sons Ltd. *Iets over de Mycologie in Scandinavie en Finland*, by Dr. H. C. Bels-Koning, paper presented by the author. *Mushroom Research Station at Yaxley*, by Dr. R. L. Edwards, paper presented by the writer. *An Aerobic Medium for Fungus Growth Studies*, by S. Burrows, paper presented by the writer.

ON THE INSULATION OF MUSHROOM HOUSES

By

Dr. R. L. EDWARDS

The summer of 1949 revealed to many growers the inadequacy of the insulation of their mushroom houses, and at the request of the Editorial Board, Dr. Edwards has revised a memorandum on the subject prepared for the M.R.A. a year or two ago. He quotes from publications by the Ministry of Fuel & Power; the Structural Insulation Association, and the Institution of Heating & Ventilating Engineers. He expresses indebtedness to Mr. Stanley Middlebrook for information and samples of some of the materials mentioned.

Many growers wish to extend their mushroom farms, and these notes are intended to summarise for their benefit the information now available on methods of insulating houses.

Good insulation delays the passage of heat in either direction through the walls, roof and floor of a building. Perfect insulation, allowing no heat at all to pass, is unattainable, and the benefit of additional insulation falls off as its total effect improves. Addition of a one inch layer of insulation might save 80% of the heat passing through a bad wall, and only 10% of that passing through a good one. The former would be a sound economic proposition, the latter might not.

The benefits derived from good insulation are even temperature, fuel economy, and freedom from condensation. The mushroom grower also gains better control of temperature for peak-heating, spawning, fumigation, and prevention of disease.

Heat is transferred in three ways,

1. by conduction through any material, including stationary air,
2. by radiation through any thermally transparent material,
3. by convection through the movement of heated air.

Many insulators prevent 1 by using the low conductivity of air, and 3 by isolating the air in a cellular structure, in which its movement is restricted. Radiation can only occur at free surfaces, and is minimised if these have a bright metallic finish.

Heat transfer is conveniently expressed as thermal transmission (U) in British Thermal Units per sq. ft. per hr. for 1 degree F. temperature difference from air to air, or for a particular material as Conductance (C) in the same units for 1 degree F. difference in temperature between the two surfaces. The reciprocal, $\frac{1}{U}$ or $\frac{1}{C}$, is the resistance (R) in degrees F. difference in temperature for the passage of 1 B. Th. Unit per sq. ft. per hr. R values can be added, and are useful for estimating temperatures. U values are used to calculate heat losses and fuel consumption. The interior and exterior surfaces of a wall offer some resistance to the passage of heat, which is expressed as a resistance (R) and varies considerably with exposure to wind.

For convenience we have taken the inside temperature of the house as 60° F. Similar considerations apply at other temperatures. Heat is lost when the outside temperature is below that in the house,

1. by movement of warm air out and of cold air into the house, the extent depending on the type and soundness of construction and on ventilation, and

2. through the floor, roof, walls, doors and windows.

Table 1 shows the heat lost in this way through various types of wall, floor, roof, and special insulating materials. The values shown must be multiplied by the area and by the difference between inside and outside temperatures to find the total heat lost under a given set of conditions. The condensation point is the outside air temperature which will cause condensation on the inside of a house kept at 60° F. and Relative Humidity 80%.

We suggest that the main outside structure of mushroom houses should have a thermal resistance (R) of at least 5. The party walls of adjoining houses need not be quite as good as this because they are not exposed to wind or to extreme cold. Better insulation will always save fuel, but will have marked effect on temperatures only in extremely hot or cold weather. Anything worse will make temperature control difficult and fuel consumption high.

This degree of insulation can be obtained with :—

(a) 13½″ brick with an air space lined with fibre board,
(b) 11″ cavity brick with an additional insulator in the middle of the cavity,
(c) wood—air—fibre board—air—wood,
(d) any outside structure lined with 1″ Onazote,
(e) any outside structure lined with fibre board or asbestos sheets and interlined with 1″ glass fibre matting, 1″ felt, or 1 layer aluminium foil in a 1″ air space,
(f) a 2″ layer of sawdust or wood wool in the roof space over any flat ceiling.

For any building to be erected or adapted now, using metal foil, resin-bonded fibreglass, sawdust, or wood wool, it would probably be worth the relatively small additional expense and labour to use a double layer of insulation. The expense of using double quantities of other more costly insulators makes generalisation inadvisable, and each case must be considered on its own merits.

Fragile materials such as metal foil and fibreglass, and loose ones such as sawdust and wood wool can be used in walls only as interlinings between two solid facing materials.

Any material which will be exposed to the air inside a mushroom house must be able to withstand the heat, moisture, and sprays to which it will sometimes be exposed. Fibreboards generally will not do so unless they have been specially treated.

The following publications deal with insulation and various aspects of fuel economy :—

Ministry of Fuel and Power Bulletins :

No. 2. Heat Insulation. (Lagging on pipes, etc.).
No. 11. Thermostatic Control for hot water and steam.
No. 12. Thermal Insulation of Buildings.
No. 43. The Furnaceman's Manual.
No. 46. How Glasshouse Growers Can Save Fuel.

Institution of Heating and Ventilation Engineers :

" The Computation of Heat Requirements for Buildings."

TABLE 1

Walls	Thickness	Thermal Transmission U	Thermal Resistance R	Condensation Point
Brick, solid	4½″	0·64	1·6	52 °F.
(ranges show variation due to varying exposure to wind)	range	0·50—0·75	2—1·3	
	9″	0·47	2·1	48°
	range	0·4—0·53	2·5—1·9	
	13½″	0·37	2·7	46°
	range	0·32—0·41	3·1—2·4	
Brick, cavity	11″	0·34	3·0	45°
	15½″	0·29	3·4	43°
Concrete	6″	0·54	1·85	51°
Wood, tongued and grooved	1″	0·50	2·0	50°
,, double with air space	2 × ½″	0·33	3·0	45°
Asbestos	¼″	0·9	1·1	54°
,, double with air space	2 × ¼″	0·45	2·2	49°
Glass, single		1·0	1·0	55°
,, double with air space ...		0·5	2·0	50°
,, ,, with ½″ wooden shutter		0·28	3·5	42°
Roofs				
Corrugated asbestos		1·4	0·7	56°
,, ,, lined ½″ board		0·5	2·0	50°
Plaster ceiling, tiled and battened roof		0·56	1·8	51°
Plaster ceiling, tiled roof with boards and felt		0·3	3·3	44°
Floors				
Concrete on earth		0·2	5	35°
Foamed slag concrete on earth		0·18	5·5	32°

TABLE 2

Walls	Thickness	R	Wt. per sq. ft.
Insulating materials (add 1 to R value if separated by an air space from other wall surfaces			
Asbestos felt boards	$\frac{1}{2}$″	1	12—14 oz.
Cork	1″	2·3—3·4	$\frac{1}{2}$—2 lb.
Hair felt	1″	3·8	15 oz.
Fibreboard	$\frac{1}{2}$″	1·4	$\frac{1}{2}$—2 lb.
Isoflex	1″	3·8	$1\frac{1}{3}$ oz.
Onazote cellular ebonite	$1\frac{1}{2}$″	7·5	10 oz.
Sawdust	1″	2·4	1 lb.
Wood wool	1″	3·5	3 oz.
Bituminous board (Lloyd)	$\frac{1}{2}$″	1·5	
	$\frac{3}{8}$″	1·1	
Pluto asbestos insulating board	$\frac{1}{2}$″	2·2—2·4	
Air space insulators :			
Any air space **not already allowed for**		1	
Any air space if between **polished metal surfaces**		2	
"Ardor" double corrugated Al. foil in 1″ air space		4·7	$\frac{1}{4}$ oz.
Double Aluminium foil on kraft paper, in 1″ air space		4·3	$\frac{1}{2}$ oz.
Cabot's quilt (triple quilted eel grass)	$\frac{3}{4}$″	2·9	$4\frac{1}{2}$ oz.
Versilent glass silk blankets, heavy grade	1″	4·5	12 oz.
Fibreglass, bitumen bonded	1″	4·2	4 oz.
Fibreglass attic insulation	4″	14	

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Aluminium Foil :—

ALFOL INSULATION LTD., 68 Victoria Street, London, S.W.1.

ARDOR INSULATION CO. LTD., 8 Southampton Row, London, W.C.1.

Asbestos :—

CAPE ASBESTOS CO. LTD., 26 Holborn Viaduct, London, E.C.1.

Compressed Felt :—

PRESSED FELT MANUFACTURERS' ASSOCIATION, Sissclough Works, Waterfoot, Rossendale, Lancs.

Corkboard :—

THE CORKBOARD ASSOCIATION, 10 Leigham Hall Parade, Streatham High Road, Streatham, London, S.W.16.

Eel Grass (Cabot's Quilt) :—

HUNTLEY & SPARKS LTD., De Burgh Road, South Wimbledon, London, S.W.19.

Fibre Building Board :—

INSULITE PRODUCTS CORPORATION LTD., Donnington House, Norfolk Street, London, W.C.2.

T. LEEMAN, 34 Palmerston Road, South Acton, London, W.3.

LLOYD BOARDS LTD., 15 Portman Street, London, W.1.

MERCHANT TRADING CO. LTD., Columbia House, Aldwych, London, W.C.2.

A. MORA, Chewton House, Keynsham, Nr. Bristol.

TENTEST FIBRE BOARD CO. LTD., 75 Crescent West, Hadley Wood, Barnet, Herts.

Foamed Slag :—

FOAMSLAG (TEES-SIDE PRODUCTION) LTD., 13/14 Dartmouth Street, London, S.W.1.

SLAG AGGREGATES LTD., Santon, Scunthorpe, Lincs.

Glass Silk Insulation : —

FIBREGLASS LTD., 10 Princes Street, Westminster, London, S.W.1.

VERSIL LTD., Rayner Mills, Liversedge, Yorks.

Slag Wool Mineral Wool :—

SLAG WOOL ASSOCIATION, Cheyne House, 62/63 Cheapside, London, E.C.2.

Wood Wool Building Slabs :—

WOOD WOOL BUILDING SLAB MANUFACTURERS' ASSOCIATION, 11 Ironmonger Lane, London, E.C.2.

Isoflex :—

BX PLASTICS, Larkswood Works, Higham Stn. Av., South Chingford, London, E.4.

Onazote :—

THE EXPANDED RUBBER CO. LTD., 675 Mitcham Road, Croydon, Surrey.

What makes fresh fruit and vegetables taste fresh? According to American food technologists, the answer is **glutamic acid.** The amount of glutamic acid is particularly high in mushrooms, which may be one reason why mushrooms enhance the flavour of so many dishes to which they are added. *B. & G. Review*, October, 1949.

Mr. Alan Collis went to the bathroom in his Consett, Co. Durham, home yesterday to clean his nails. He found a mushroom sprouting from his **nailbrush.** Its stalk was 2 in. long, its top 1 in. across. Mr. Collis had gathered mushrooms the day before. Said he : " Spawn must have been transferred from my fingernails to the brush."
(EDITOR'S NOTE : Spawning to picking, 24 hrs.!) *Daily Mail*, 21.10.49.

" Scottish folk haven't yet learnt to eat mushrooms," says Mr. M. H. Pinkerton, " but there's always a bonny market south of the Border. Most of my mushrooms go to England—chiefly the North and Midlands, but also to London—where the demand is steady and consistent " . . . . . To-day (his) area under cultivation is upward of 250,000 sq. ft., the **output is enormous,** and the undertaking is still growing . . . . . It is anticipated that 84,000 sq. ft. of extra production area will be in use by Christmas. *Fruit Grower*, 6.10.49.

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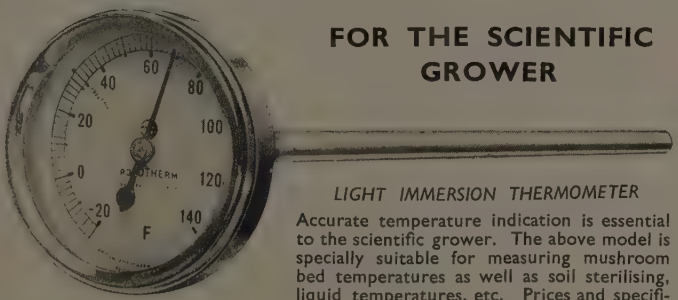

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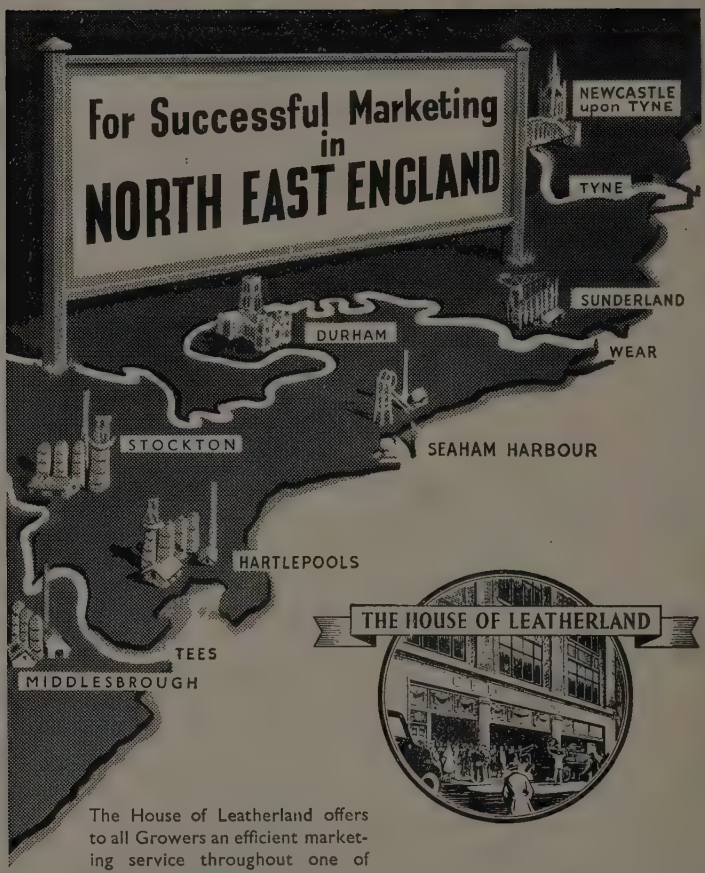

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PERCY EDGERTON, *Principal,*
For and on behalf of
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